

CeraDiode

Consumer Applications



Benefits for customer applications

What is CeraDiode?

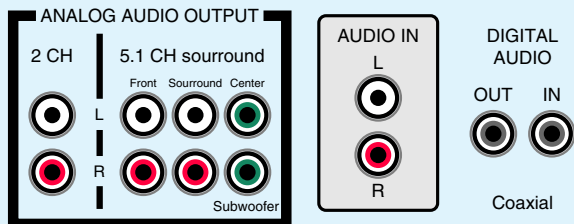
EPCOS CeraDiode is an ESD protection device: an alternative to and replacement for semiconductor diodes such as Zener and TVS diodes.

CeraDiode offers advantages over semiconductor diodes:

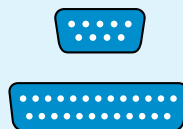
- 1) Bi-directional protection in a single component
- 2) No change in ESD protection performance at temperatures $> 25\text{ }^{\circ}\text{C}$
- 3) Use of parasitic capacitance for RFI suppression and HF filtering (replacement of additional MLCC)
- 4) Lower leakage current
- 5) Fast response time $< 0.5\text{ ns}$
- 6) Greater ruggedness against surge currents
- 7) Component dimensions
- 8) Optimized placement and quality costs

Interfaces ESD protected by CeraDiode

Audio



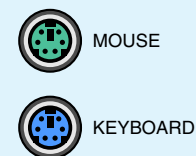
Serial/Parallel



ISDN/ xDSL modem



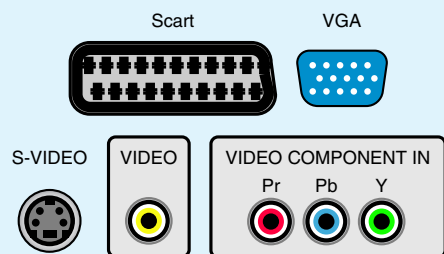
PS/2



Push button



Video



HDMI/DVI



USB/ IEEE 1394



Ethernet LAN



Memory card



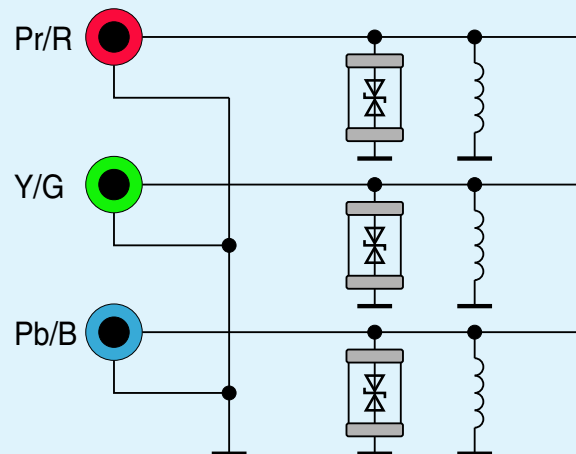
Protection for video

Requirements on the CeraDiode:

- 1) ESD protection to IEC 61000-4-2
- 2) Low capacitance to prevent signal distortion on the data line

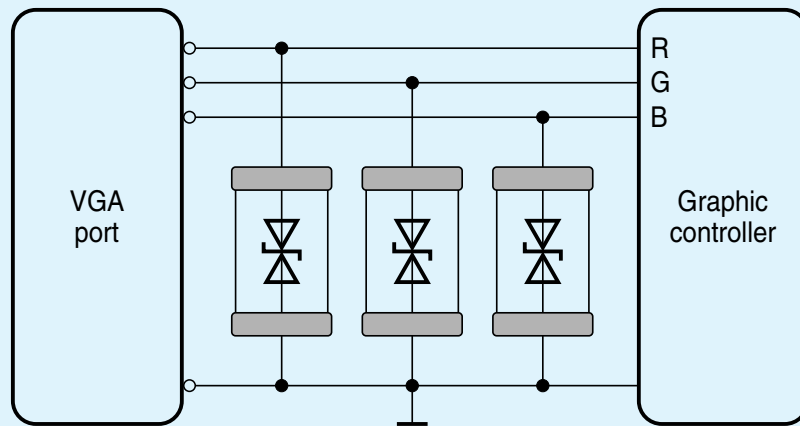
CeraDiodes:

- Single 0603 (47 pF) and array 0612 (56 pF); lower frequencies
- Single 0402, 0603 and array 0508 (all 10 pF); high frequencies up to 200 MHz
- Single 0402, 0603, 1003 and array 0612 (all 3 pF); frequencies above 240 MHz
- Array 1012 CDA6C05GTH (7 pF)

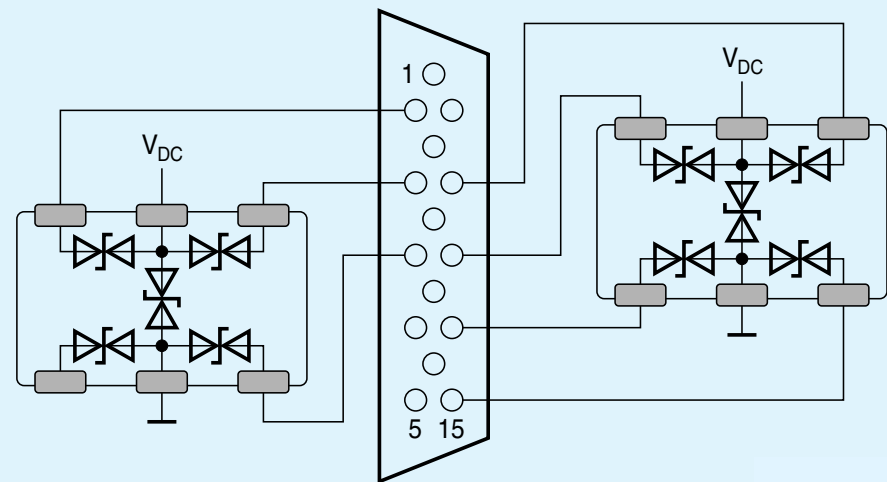


Protection of video lines and controllers

Protection for video



Protection of VGA lines and controllers



Protection of video lines and controllers
with CDA6C05GTH

Protection for audio

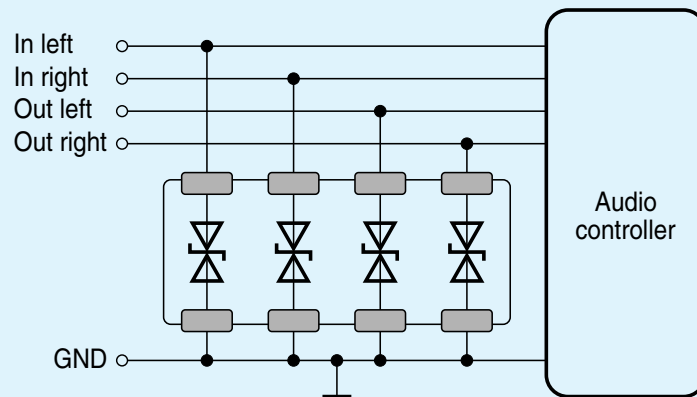
CeraDiodes satisfy the requirements on audio line protection devices for ESD and EMI in a single component.

Requirements on the CeraDiode:

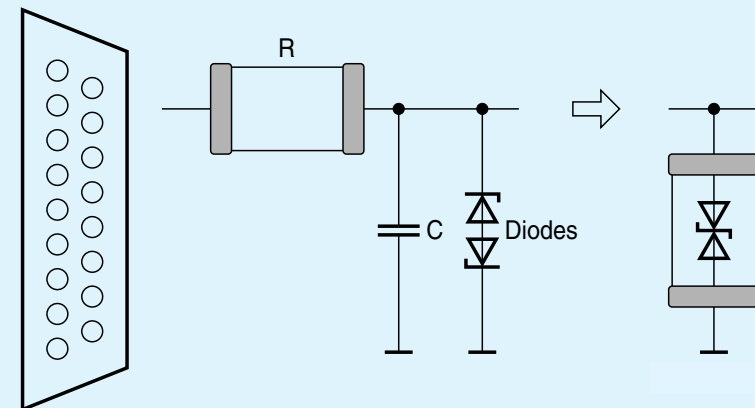
- 1) ESD protection to IEC 61000-4-2
- 2) High-frequency noise filtering for high quality audio signals
- 3) Bi-directional operation and low line capacitance for digital audio systems

CeraDiodes:

- Single 0402 and 0603 with a capacitance of 47 pF to 470 pF
- Array 0508 (33 pF) and 0612 (56 pF)

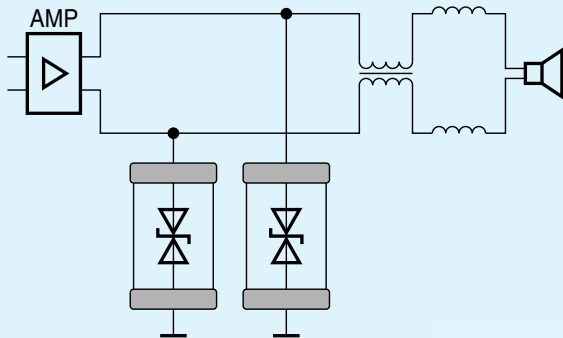


Protection of VGA lines and controllers
with CDA5C20GTA

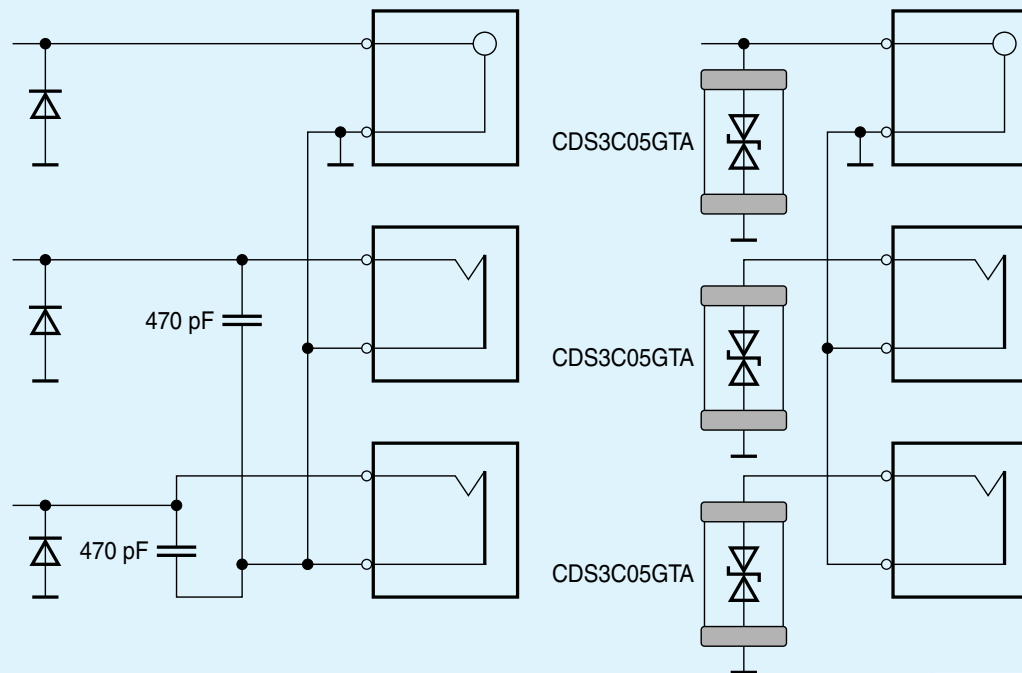


Protection of video lines and controllers

Protection for audio

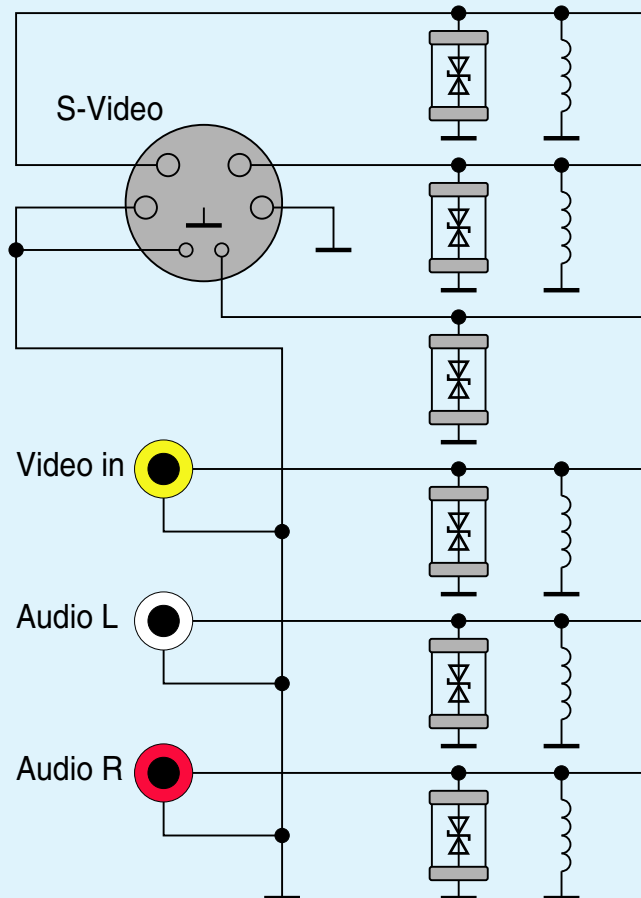


Audio line and EMI protection in one component for headset application with CDS3C05GTA (470 pF)



Audio line and EMI protection in one component for RCA connector with three CeraDiodes (470 pF; on left) instead of three semiconductor diodes and two capacitors (on right; space and cost saving)

Protection for combined video and audio



ESD protection for combined audio and video input lines:
S-Video, composite video and audio

Protection for DVI

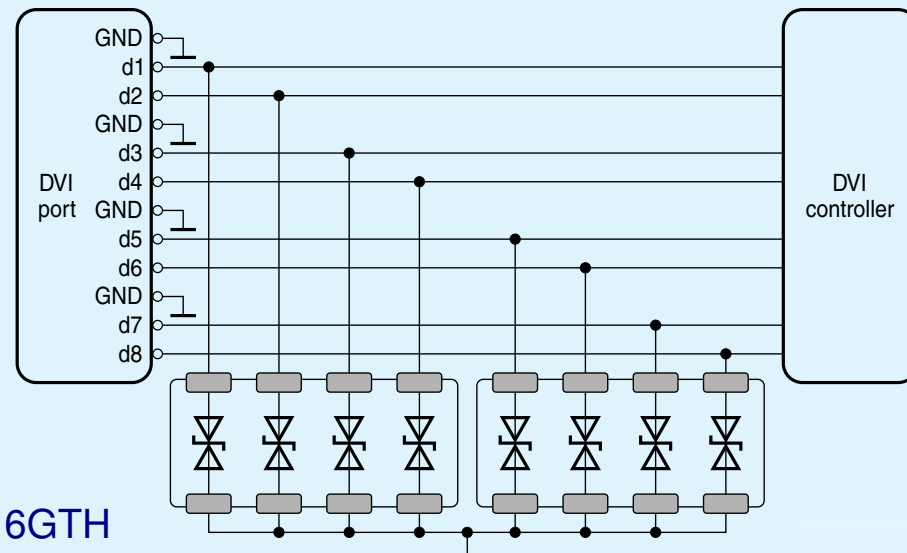
With the advent of flat panel displays (LCD and plasma), DVI and HDMI have become established as the digital audio and video interfaces between computers and monitors (DVI) and between DVD players / recorders, set-top boxes, etc. and TV sets (HDMI). Their high-frequency operation requires a very low / an ultra low line capacitance to avoid signal distortion.

Requirements on the CeraDiode:

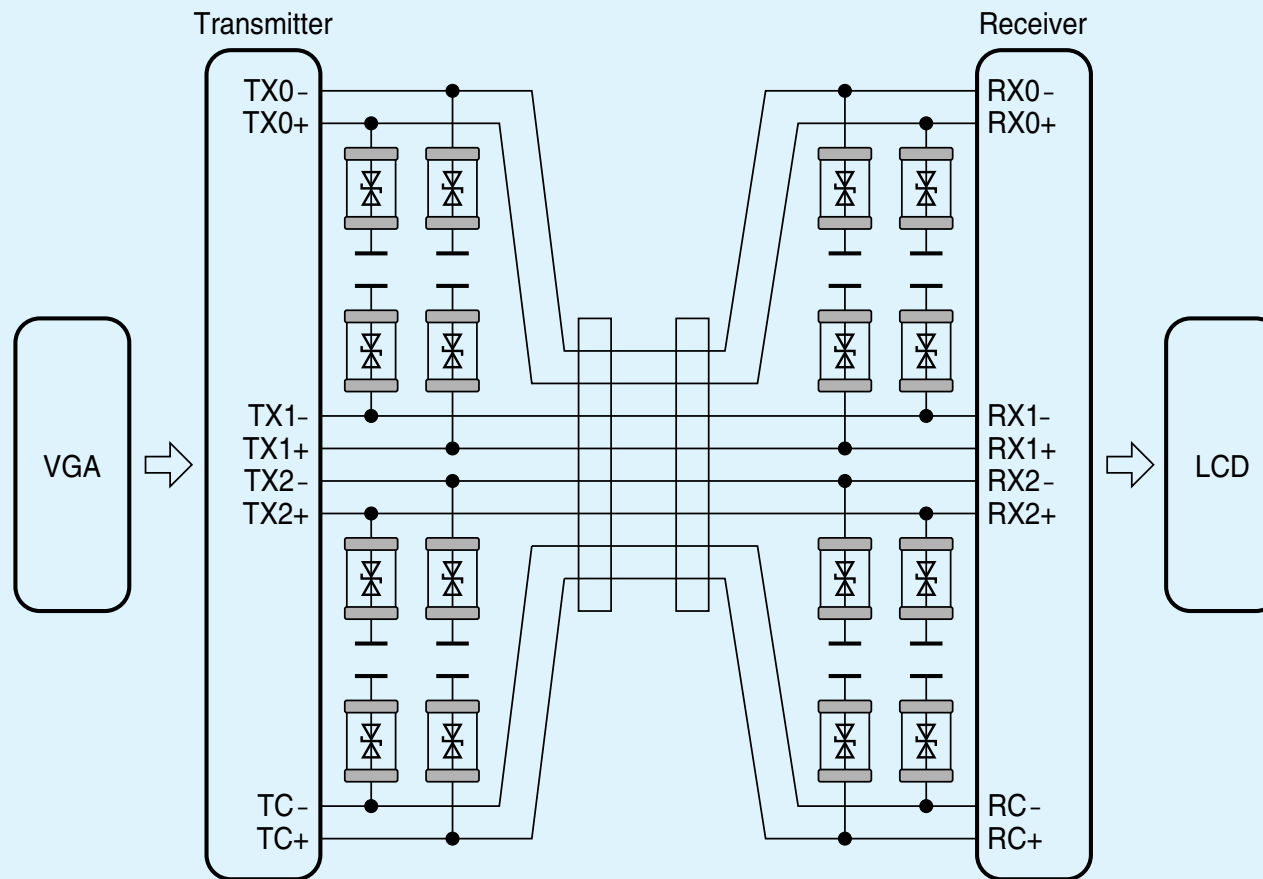
- 1) ESD protection for high-speed data and video transmission to IEC 61000-4-2, level 4
- 2) Very low and ultra low capacitance to prevent signal distortion on the data line

CeraDiodes:

- Single 0402, 0603 and 1003 with a capacitance of 0.6 pF to 10 pF
- Array 0612 (3 pF)



Protection for DVI and HDMI



Protection of DVI or HDMI with CDS2C05HDMI1

Protection for USB

The Universal Serial Bus (USB) has become the standard interface for data systems. As data and consumer electronics have merged, USB has spread into more and more electronic devices. USB is extremely sensitive to ESD. Data rates up to 480 Mbit/s require a very low line capacitance to avoid signal distortion. USB uses two (high-speed) data lines.

Requirements on the CeraDiode:

- 1) ESD protection for high-speed data transmission to IEC 61000-4-2, level 4
 - 2) Very low capacitance to prevent signal distortion on the data line
-

CeraDiodes (USB 1.1 data lines with data rates up to 12 Mbit/s):

- Single 0402, 0603 and 1003 with a capacitance of 10 pF to 82 pF
- Array 0508 (33 pF) and 0612 (56 pF)

CeraDiodes (USB 2.0 data lines with data rates up to 480 Mbit/s):

- Single 0402, 0603 and 1003 with a capacitance of 2 pF to 10 pF
- Array 0508 (10 pF) and 0612 (3 pF)

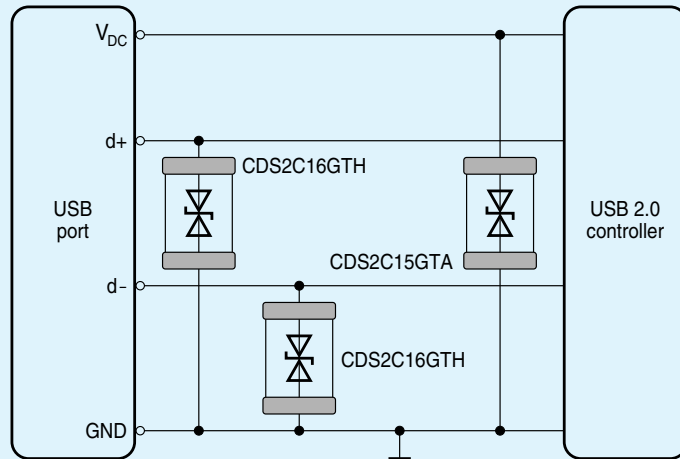
CeraDiode (power line):

Single 0402 (CDS2C15GTA) and 0603 (CDS3C15GTA)

CeraDiode (USB 2.0 data and power line):

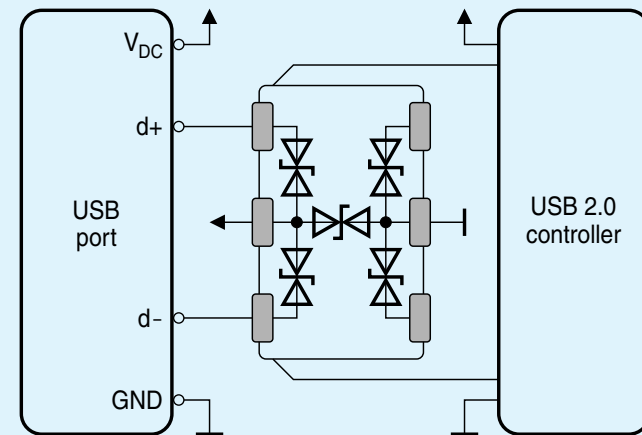
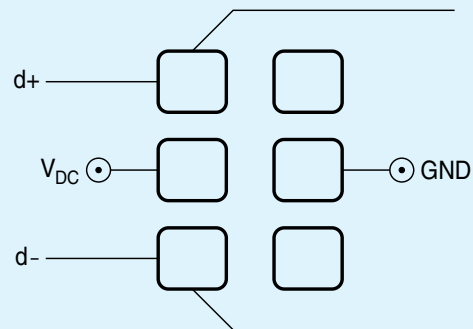
Array 1012 up to 4 data lines and 1 supply line CDA6C05GTH (7 pF)

Protection for USB (single port)

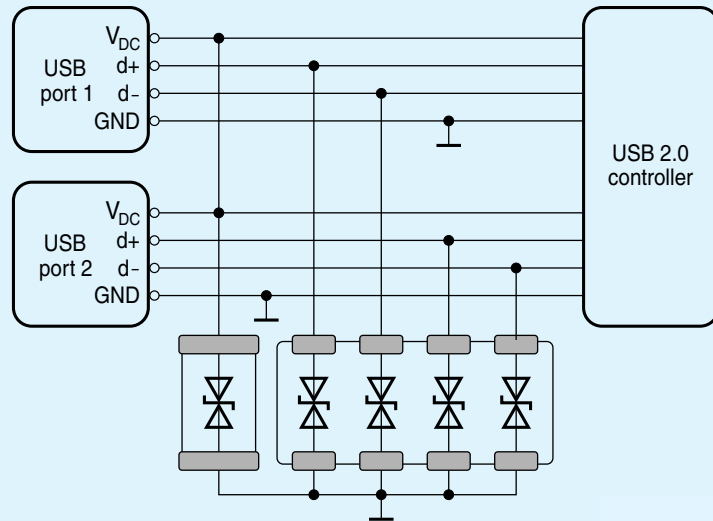


ESD protection with single CeraDiodes

ESD protection with CDA6C05GTH

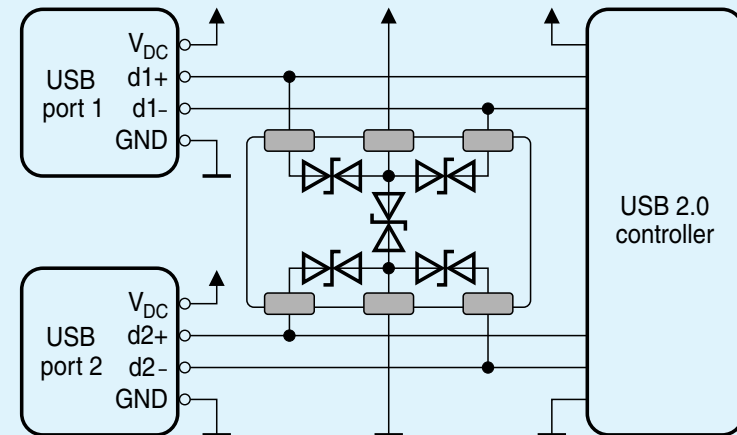
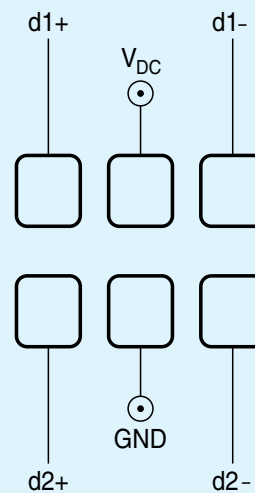


Protection for USB (dual port)



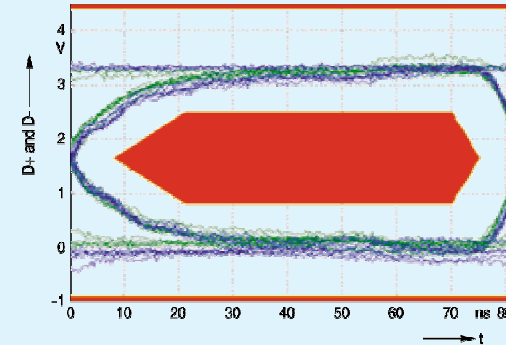
ESD protection with a single CDS3C16GTA and a CDA5C16GTH array

ESD protection with CDA6C05GTH

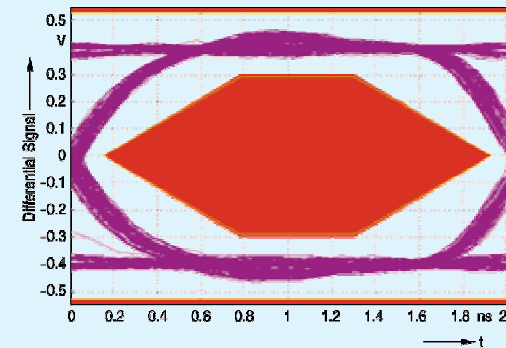


Protection for USB: Compliance measurements

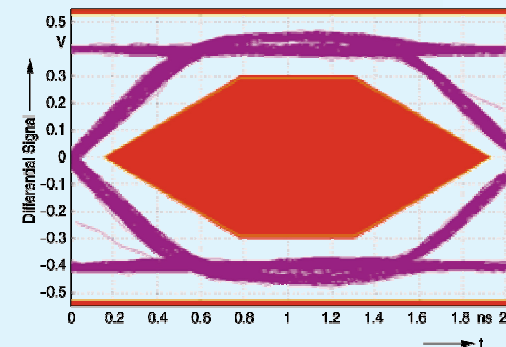
Full-speed measurement (12 Mbit/s) with
CDS4C12GTA (82 pF):



High-speed measurement (480 Mbit/s) with
CDS2C16GTH (2 pF):



High-speed measurement (480 Mbit/s) with
CDA6C05GTH (7 pF):



Protection for IEEE 1394 (Firewire, DV)

IEEE 1394 interfaces are better known as Firewire connectors in computers or as DV digital connectors between camcorders and DVD players and recorders. There are two versions with 6 and 4 lines respectively. Their data transfer rate is comparable to that of USB 2.0.

Requirements on the CeraDiode:

- 1) ESD protection for high-speed data transmission to IEC 61000-4-2, level 4
 - 2) Very low capacitance to prevent signal distortion on the data line
-

CeraDiodes (data lines):

- Single 0402, 0603 and 1003 with a capacitance of 0.6 pF to 10 pF
- Array 0508 (10 pF) and 0612 (3 pF)

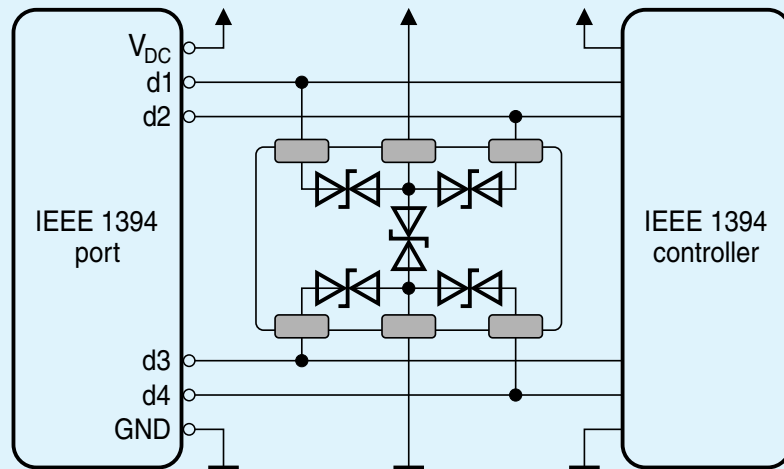
CeraDiode (power line):

Single 0402 CDS2C15GTA and 0603 CDS3C15GTA

CeraDiode (data and power line):

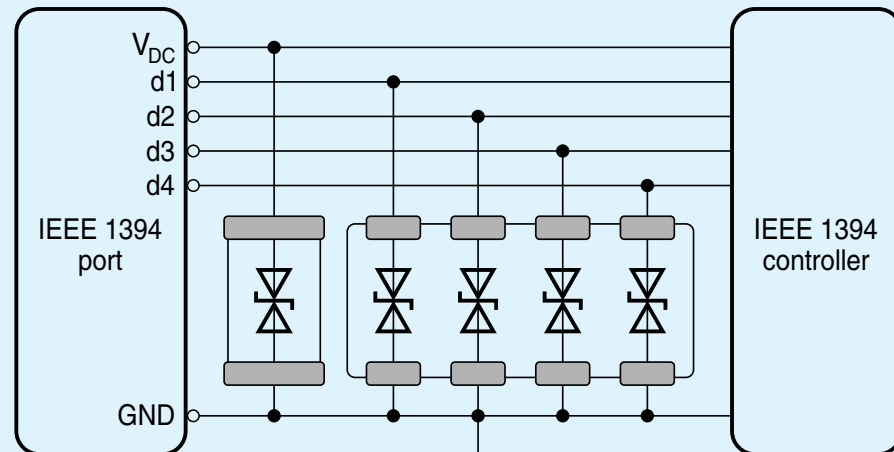
Array 1012 4 data lines and 1 supply line CDA6C05GTH (7 pF)

Protection for IEEE 1394 (Firewire, DV)



ESD protection with CDA6C05GTH

ESD protection with a single CDS3C15GTA and a CDA5C16GTH array



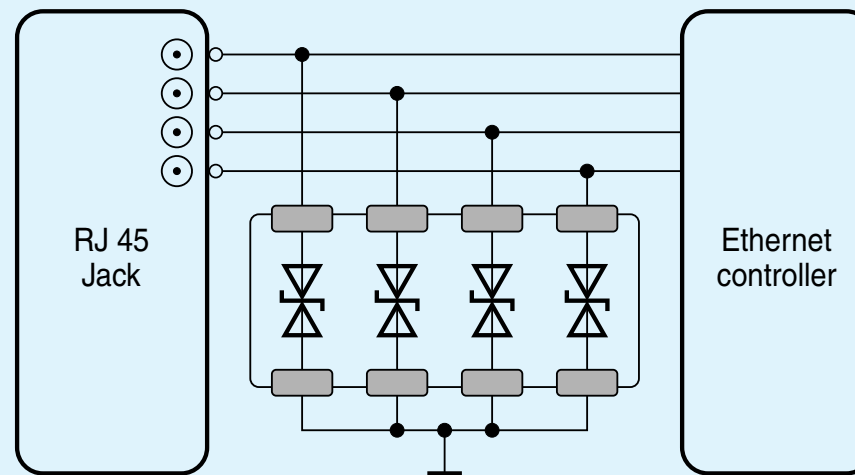
Protection for Ethernet

Requirements on the CeraDiode:

- 1) ESD protection for high-speed data transmission to IEC 61000-4-2, level 4
- 2) Very low capacitance to prevent signal distortion on the data line

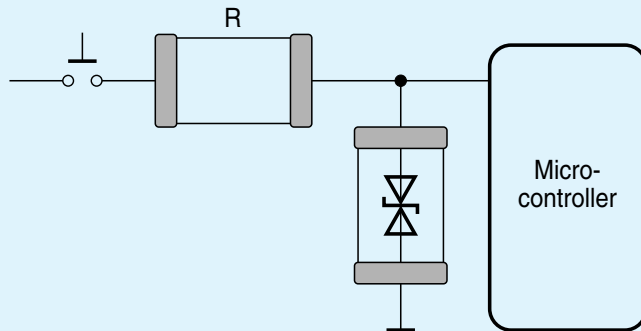
CeraDiodes:

- Single 0402, 0603 and 1003 with a capacitance of 0.6 pF to 10 pF
- Array 0508 (10 pF) and 0612 (3 pF)



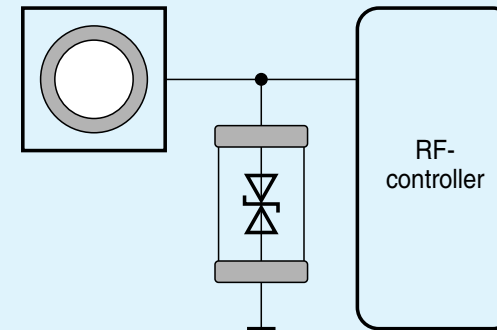
Protection for other applications

Keyboard and pushbuttons



It is important to protect the keyboard in order to avoid an ESD arc entering the circuit through the pushbuttons, e.g. with CDS3C20GTA.

RF inputs and outputs

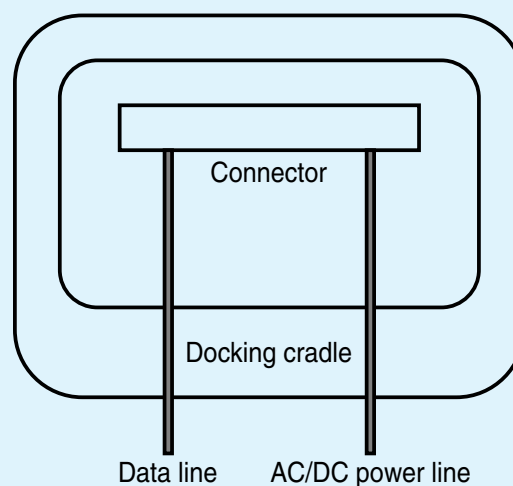


The protection device should have a very low capacitance value and insertion loss, e.g. the CDS3C16GTH (3 pF).

Protection for other applications

Docking stations and cradles:

The docking station and cradle set up the primary connection for both the data transfer between portable device and host computer and for charging battery. CeraDiodes for data line protection depend on the type of connection (USB, Ethernet, Firewire, etc.), see slides above.



Block diagram of a docking station / cradle for portable devices

Application matrix

				Video analog (Scart, Composite, Component, S-Video, VGA)	Audio analog	Audio digital	DVI	HDMI	LCD	USB	IEEE 1394 (Firewire, DV, i.Link)	Ethernet	SATA	Serial port	Parallel port	Memory card	SIM card	Analog modem / ISDN	xDSL modem	Keyboard, Pushbuttons, PS/2
Devices	Case size	EPCOS type code	Semi-diode package																	
Single standard	0402	CDS2C05GTA	SOD-723		x	x ¹⁾								x				x	x ¹⁾	x
	0402	CDS2C15GTA	SOD-723		x	x ¹⁾				x ²⁾				x				x	x ¹⁾	x
	0603	CDS3C05GTA	SOD-523		x	x ¹⁾								x				x	x ¹⁾	x
	0603	CDS3C09GTA	SOD-523		x	x ¹⁾								x				x	x ¹⁾	x
	0603	CDS3C15GTA	SOD-523		x	x ¹⁾				x ²⁾	x ²⁾			x				x	x ¹⁾	x
	0603	CDS3C20GTA	SOD-523	x ¹⁾	x	x ¹⁾								x				x	x ¹⁾	x
	1003	CDS4C12GTA	SOD-323		x	x ¹⁾								x				x	x ¹⁾	x
Array standard	0508	CDA4C20GTA	-	x ¹⁾	x	x			x ¹⁾	x ³⁾				x				x	x ¹⁾	x
	0612	CDA5C20GTA	-	x ¹⁾	x	x			x ¹⁾	x ³⁾				x				x	x ¹⁾	x
Single high-speed	0402	CDS2C05HDMI1	SOD-723				x	x			x	x	x							
	0402	CDS2C15GTH	SOD-723	x		x			x ¹⁾	x	x				x	x	x		x	
	0402	CDS2C16GTH	SOD-723	x		x	x		x	x	x	x	x		x	x			x	
	0603	CDS3C16GTH	SOD-523	x		x	x		x	x	x	x	x		x	x			x	
	0603	CDS3C30GTH	SOD-523	x		x			x ¹⁾	x	x	x ¹⁾			x	x			x	
	1003	CDS4C16GTH	SOD-323	x		x	x		x	x	x	x	x		x	x			x	
Array high-speed	0508	CDA4C16GTH	-	x		x			x ¹⁾	x	x	x ¹⁾			x	x	x		x	
	0612	CDA5C16GTH	-	x		x	x		x	x	x	x	x		x	x			x	
	1012	CDA6C05GTH	SOT-23 6L	x		x				x	x	x	x		x	x	x		x	

¹⁾ Small data rates only

²⁾ Power line

³⁾ USB 1.1 only

Customer has to test and approve parts for the application.